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## (54) EPOXY RESIN COMPOSITION AND POWDER COATING

(57)Abstract:

PROBLEM TO BE SOLVED: To obtain an epoxy resin composition which has excellent heat and crack resistances by the forced cooling off after the heat curing, excellent appearance of coating film, and so on, and is suitable as a powder coating by incorporating an epoxy resin, curing agent, curing promotor, glass as an inorganic filler, and silicone rubber as a stress-relaxing agent.

SOLUTION: This composition is obtained by incorporating (A) an epoxy resin, preferably a mixed resin consisting of 450-1,000 epoxy equivalents of a bisphenol-type epoxy resin and 190-220 epoxy equivalents of a novolak-type multifunctional epoxy resin, (B) a curing agent, preferably dicyandiamide, (C) a curing promotor, preferably an imidazole-based azine derivative, (D) glass as an inorganic filler, preferably glass beads having a DPH50 value of 750 kg/mm<sup>2</sup> or less, and (E) silicone rubber as a stress-relaxing agent.

## LEGAL STATUS

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TITLE: Epoxy resin composition for powder paint providing coating having good appearance and improved resistance against cracking and heat cycle

PATENT-ASSIGNEE: NIPPON KAYAKU KK[NIPK]

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ABSTRACTED-PUB-NO: JP2000143938A

BASIC-ABSTRACT:

NOVELTY - A new epoxy resin composition comprises (A) an epoxy resin, (B) a curing agent, (C) a curing promoter, (D) glass as an inorganic filler, and (E) silicone rubber as a stress moderating agent.

USE - For fixing coils of high speed rotors for starter motors of two or four-wheel cars.

ADVANTAGE - The new epoxy resin composition is easy to impregnate, providing a cured body having improved resistance against heat cycling.

CHOSEN-DRAWING: Dwg.0/0

TITLE-TERMS: EPOXY RESIN COMPOSITION POWDER PAINT COATING APPEAR IMPROVE RESISTANCE CRACK HEAT CYCLE

DERWENT-CLASS: A21 A26 G02 L03 X11 X12 X22

CPI-CODES: A05-A02; A06-A00B; A07-A03B; A08-D; A08-D04; A08-P; A08-R04; A10-E08C; A12-E08B; G02-A05B; L03-D05A;

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ENHANCED-POLYMER-INDEXING:

Polymer Index [1.1]

018 ; G1570\*R G1558 D01 D11 D10 D23 D22 D31 D42 D50 D69 D73 D83  
F47 7A ; R00470 G1161 G1150 G1149 G1092 D01 D11 D10 D19 D18 D32  
D50 D76 D93 F32 F30 ; H0022 H0011 ; P0464\*R D01 D22 D42 F47 ; P1898\*R  
P0464 D01 D10 D11 D18 D19 D22 D42 D76 F34 F47 ; S9999 S1514 S1456  
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Polymer Index [1.2]

018 ; G1116\*R G1105 G1092 D01 D11 D10 D19 D18 D31 D50 D76 D87 F31  
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**\* NOTICES \***

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2. \*\*\*\* shows the word which can not be translated.
3. In the drawings, any words are not translated.

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**DETAILED DESCRIPTION**

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[Detailed Description of the Invention]

[0001]

[Field of the Invention] Especially this invention relates to the epoxy resin system powder coatings which were excellent in thermal resistance, the crack-proof nature by forced cooling after heat hardening, a paint film appearance, and thermo-cycle-proof nature, and were excellent in especially periphery cutting processability, in order to fix the coil of the locked rotor of two flowers or the Starter motor for four-wheel cars about an epoxy resin constituent and powder coatings.

[0002]

[Description of the Prior Art] In order to make the coil of a rotator of a motor, a generator, etc. used under an elevated temperature or a high speed fix conventionally, using an epoxy resin system liquefied varnish is known. This liquefied varnish is used for the purpose of the vibration of a coil and rose \*\*\*\*\* under protection of the coil under an elevated temperature, or high-speed rotation. the case where a liquefied varnish is not used -- the bottom of an elevated temperature -- the heat deterioration of the coil itself -- moreover, under high-speed rotation, vibration and rose injury student \*\* of a coil, and all cause trouble to the function of rotator original. In order to solve this trouble, the approach of fixing a coil with a liquefied varnish is adopted. After making it sink in and harden, specifically dropping and heating a liquefied varnish in the rotator core containing a coil, or core space, cutting processing is performed to extent to which a core surface of metal exposes excessive hardening resin from this rotator core front face with a cutting tool cutting edge etc., and it considers as a rotator.

[0003] When producing a locked rotor using an epoxy resin system liquefied varnish, the following process is usually taken. That is, in order to heat the whole rotator core containing a coil to homogeneity so that (1) liquefied varnish may tend to sink in, a temperature up is carried out over many hours. (2) A liquefied varnish is dropped at the rotator core containing the heated coil, and hypoviscosity-ize a liquefied varnish, make it get wet and spread and make it sink in into a coil or core space. (3) Make the hypoviscosity-ized liquefied varnish gel. (4) Usually, heat further for 1 to 2 hours, and stiffen a liquefied varnish completely. (5) Carry out cutting processing with a cutting tool cutting edge etc. at extent to which a core surface of metal exposes excessive hardening resin after full hardening. Thus, when using an epoxy resin system liquefied varnish, a production process is long and productive efficiency is low. On the other hand, if the gelation time is brought forward in order to gather productive efficiency, the impregnating ability of a liquefied varnish becomes inadequate, and the fixing force of a coil will decline and it will become a defective. Moreover, since a liquefied varnish had short pot life, it was not reusable, and since viscosity was still lower, the lappet of a varnish arose before gelation, the amount of the liquefied varnish used increased, and the problem that cost rose was mentioned. In addition to these problems, contamination of work environment, the problem of an operator's insurance, etc. are mentioned by the odor accompanying use of the lappet of a liquefied varnish, or an organic solvent etc. It is pollution-free in order to solve these troubles, and powder coating possible [ reuse of a coating ] and very [ in cost ] advantageous attracts attention.

[0004]

[Problem(s) to be Solved by the Invention] However, in order to raise productive efficiency in the conventional powder coatings and to carry out forced cooling of the rotator after heat hardening to a room temperature from 180 degrees C, it had the problem of producing a crack in a paint film. Although there is the approach of adding a silica with a low linear-expansion property as a filler in order to solve these problems, in this case, the degree of hardness of a silica is too high at the time of motor periphery cutting in the culmination of a production process, wear of a cutting tool cutting edge is remarkably brought forward at it, and the problem of reducing productive efficiency arises. For this reason, powder coatings suitable for the locked rotors which were excellent in thermal resistance, the crack-proof nature by forced cooling after heat hardening, a paint film appearance, and thermo-cycle-proof nature, and were excellent also in periphery cutting processability especially with a cutting tool cutting edge are desired.

[0005]

[Means for Solving the Problem] That a technical problem which was described above should be solved, this invention persons find out that the powder coatings which are satisfied with coincidence of the above-mentioned engine performance are obtained, as a result of repeating research wholeheartedly. This invention Namely, (1) epoxy resin (A), a curing agent (B), a hardening accelerator (C), The epoxy resin constituent which contains silicone rubber (E) as glass (D) and a stress relaxation agent as an inorganic filler, (2) The epoxy resin constituent of (1) whose an epoxy resin (A) is mixed resin of the bisphenol mold epoxy resin (a) of weight per epoxy equivalent 450-1000, and the novolak mold polyfunctional epoxy resin (b) of weight per epoxy equivalent 190-220, (3) (1) or (2) epoxy resin constituents whose curing agent (B) is a dicyandiamide, (4) (1) whose a hardening accelerator (C) is an imidazole system azine derivative thru/or the epoxy resin constituent of any 1 term of (3), (5) (1) whose glass (D) is a glass bead thru/or the epoxy resin constituent of any 1 term of (4), (6) The epoxy resin constituent of (5) whose a glass bead (D) is a glass bead which has DPH50 value of two or less [ 750kg //mm ], (7) (5) or the epoxy resin constituent of (6), [0006] whose a glass bead (D) is a glass bead which has the coefficient of linear expansion below  $90 \times 10^{-7}$  (1-/degree C)) (8) (5) whose content of the bead which has the particle size of 250 micrometers or more in a glass bead (D) is 10 or less % of the weight thru/or the epoxy resin constituent of any 1 term of (7), (9) (5) whose a glass bead (D) is a soda ash glass bead thru/or the epoxy resin constituent of any 1 term of (8), (10) (5) whose a glass bead (D) is a bead made from way silica glass thru/or the epoxy resin constituent of any 1 term of (9), The epoxy resin powder coatings which consist of an epoxy resin constituent of any 1 term of (11), (1), or (10), The goods painted with the epoxy resin powder coatings of (12) and (11) and (13) goods are related with the motor which has the goods of (12) which is a locked rotor, and the locked rotor of (14) and (13).

[0007]

[The gestalt of invention implementation] The epoxy resin constituent of this invention is a solid-state-like epoxy resin constituent at 25 degrees C, and contains silicone rubber (E) as glass (D) and a stress relaxation agent as an epoxy resin (A), a curing agent (B), a hardening accelerator (C), and an inorganic filler. Although the heterocycle type epoxy resin which has heterocycles, such as cycloaliphatic epoxy resin which has aliphatic series frames which the glycidyl ether radical has combined with the phenol system compound, for example, such as an epoxy resin and a cyclohexane, as an epoxy resin (A), an isocyanuric ring, and a hydantoin ring, is mentioned, the epoxy resin which the glycidyl ether radical has combined with the phenol system compound is desirable. these epoxy resins -- 25 degrees C -- a solid-state-like thing -- desirable -- moreover, a kind -- or two or more sorts can be mixed and it can use.

[0008] As a phenol system compound in the epoxy resin which the glycidyl ether radical has combined with the above-mentioned phenol system compound For example, a bisphenol A, Bisphenol F, Bisphenol S, 4, and 4'-biphenyl phenol, 2 and 2'-methylenebis (4-methyl-6-tert-butylphenol), 2 and 2'-methylenebis (4-ethyl-6-tert-butylphenol), 4 and 4'-BUCHIEN-screw - (3-methyl-6-tert-butylphenol), 1, 1, 3-tris (2-methyl-4-hydroxy-5-tert-butylphenol), A tris HODOROKISHI phenylmethane, pyrogallol, the phenols that have a diisopropylidene skeleton, A polyphenol compound, various kinds of novolak resin, etc., such as phenols which have fluorene frames, such as a 1 and 1-G 4-hydroxyphenyl fluorene,

and phenol-ized polybutadiene, are mentioned. As various kinds of novolak resin, various novolak resin, such as novolak resin which uses various phenols, such as a phenol, cresol, ethylphenol, butylphenol, octyl phenol, bisphenol A, Bisphenol F, Bisphenol S, and naphthols, as a raw material, xylylene frame content phenol novolak resin, dicyclopentadiene frame content phenol novolak resin, and fluorene frame content phenol novolak resin, is mentioned.

[0009] When the fluidity (blocking nature under storage) of the fine particles at the time of paint and the permeability (melt viscosity of powder coatings) of this coating inside a rotator coil are taken into consideration among these epoxy resins, use of the bisphenol mold epoxy resin which carried out epoxidation of bisphenol A, Bisphenol F, the bisphenol S, etc., or a novolak mold polyfunctional epoxy resin is desirable. In the case of a bisphenol mold epoxy resin, it is desirable, and the thing of 450-1000 is good, and 450-4000, and when it is a novolak mold polyfunctional epoxy resin, the thing of weight per epoxy equivalent 190-220 is more preferably desirable [ the weight per epoxy equivalent ]. Novolak mold polyfunctional epoxy resins are two or more epoxy resins which 4-10 glycidyl ether radicals have combined preferably at the various aforementioned novolak resin.

[0010] Moreover, when giving high Tg according to an application, use of a novolak mold polyfunctional epoxy resin, especially the novolak mold polyfunctional epoxy resin of weight per epoxy equivalent 190-220 is desirable. If a novolak mold polyfunctional epoxy resin is used together to a bisphenol mold epoxy resin, crack-proof nature, thermo-cycle-proof nature, and impregnating ability can be satisfied to coincidence, maintaining a high Tg point. (a) weight per epoxy equivalent can combine with a kind of the bisphenol mold epoxy resin of 450-4000, two or more sorts and a kind of the novolak mold polyfunctional epoxy resin of the (b) weight per epoxy equivalent 190-220, or two sorts or more in this case. It is a kind of the bisphenol A mold epoxy resin (a-1) of weight per epoxy equivalent 450-4000, two or more sorts and a kind of the novolak mold polyfunctional epoxy resin (b-1) of weight per epoxy equivalent 190-220, or two sorts or more of combination preferably, and they are a kind of the bisphenol A mold epoxy resin (a-2) of weight per epoxy equivalent 450-1000, two or more sorts and a kind of the novolak mold polyfunctional epoxy resin (b-2) of weight per epoxy equivalent 190-220, or two sorts or more of combination especially preferably. As for the operating rate, it is desirable to use it by (a):(b) =20:80-80:20, and to use at a rate of (a):(b) =35:65-65:35 still more preferably as the weight section.

[0011] As a curing agent (B) used by this invention, an acid anhydride, amines, phenols, amides, imidazole derivatives, etc. are mentioned, for example. As an acid anhydride, alicyclic carboxylic anhydrides, such as the anhydride of aliphatic carboxylic acid, such as aromatic series carboxylic anhydrides, such as a phthalic-acid anhydride, trimellitic anhydride, a pyromellitic acid anhydride, a benzophenone tetracarboxylic acid anhydride, and ethylene glycol trimellitic anhydride, an azelaic acid, a sebacic acid, and dodecane diacid, a tetrahydrophthalic anhydride, a hexahydrophthalic anhydride, a NAIKKU acid anhydride, a beef fat acid anhydride, and himic acid anhydride, etc. are mentioned, for example.

[0012] As amines, diamino diphenylmethane, diamino diphenyl sulfone, diamino diphenyl ether, etc. are mentioned, for example, and a dicyandiamide etc. is mentioned as amides. As phenols, for example Bisphenol A, tetra-bromine bisphenol A, A Bisphenol F, Bisphenol S, 4, and 4'-biphenyl phenol, 2 and 2'-methylenebis (4-methyl-6-tert-butylphenol), 2 and 2'-methylenebis (4-ethyl-6-tert-butylphenol), 4,4'-butyrylene-bis(3-methyl-6-tert-butylphenol), 1, 1, 3-tris (2-methyl-4-hydroxy-5-tert-butylphenol), Tris hydroxyphenyl methane, pyrogallol, the phenols that have a diisopropylidene skeleton, The phenols which have fluorene frames, such as a 1 and 1-G 4-hydroxyphenyl fluorene, Polyphenol compounds, such as phenol-ized polybutadiene, a phenol, Cresol, ethylphenol, butylphenol, and octyl phenol Bisphenol A, bromine-ized bisphenol A, Bisphenol F The novolak resin which uses various phenols, such as Bisphenol S and naphthols, as a raw material, Various novolak resin, such as xylylene frame content phenol novolak resin, dicyclopentadiene frame content phenol novolak resin, and fluorene frame content phenol novolak resin, etc. is mentioned.

[0013] As imidazole derivatives, for example 2-methylimidazole, 2-phenylimidazole, 2-undecylimidazole, 2-heptadecylimidazole, 2-phenyl-4-methylimidazole, 1-benzyl-2-phenylimidazole, 1-

benzyl-2-methylimidazole, 1-cyanoethyl-2-methylimidazole, 1-cyanoethyl-2-phenylimidazole, 1-cyanoethyl-2-undecylimidazole, 2, 4-diamino-6 (2'-methyl imidazole (1')) ethyl-s-triazine, 2, 4-diamino-6 (2'-undecyl imidazole (1')) ethyl-s-triazine, 2, 4-diamino-6 (2'-ethyl, 4-methyl imidazole (1')) ethyl-s-triazine, 2 A 4-diamino-6 (2'-methyl imidazole (1')) ethyl-s-triazine isocyanuric acid addition product, 2:3 addition products of 2-methylimidazole isocyanuric acid, a 2-phenylimidazole isocyanuric acid addition product, The 2-phenyl -3, 5-dihydroxy methyl imidazole, a 2-phenyl-4-hydroxymethyl-5-methyl imidazole, The 1-cyano ethyl-2-phenyl -3, the various imidazole derivatives of 5-dicyano ethoxy methyl imidazole, And salts with multiple-valued carboxylic acids, such as these imidazole derivatives, a phthalic acid, isophthalic acid, a terephthalic acid, trimellitic acid, pyromellitic acid, naphthalene dicarboxylic acid, a maleic acid, and oxalic acid, etc. are mentioned.

[0014] Although suitably chosen by the application of powder coatings, the property, etc., it is acid anhydrides, phenol novolak resin, and amides preferably which curing agent is used among these curing agents (B), and it is a dicyandiamide still more preferably. In the equivalent ratio of a curing agent to the epoxy group of an epoxy resin (A), the range of the amount of the curing agent used is usually 0.3-2.0, the range of it is 0.4-1.5 preferably, and it is used in 0.5-1.0 still more preferably. Moreover, the above-mentioned curing agent can also mix and use two or more sorts. When the above-mentioned curing agent is smaller than 0.3, the fall of the adhesive strength of a powder-coatings hardened material is caused, and when [ than 2.0 ] more, at the time of paint, the melt viscosity of epoxy resin powder coatings becomes high, or foams with a rapid hardening reaction, and there is an inclination for the impregnating ability of a between [ a coil or a core ] to become scarce.

[0015] As a hardening accelerator (C) which can be used for this invention, phenols, such as phosphines, such as salts of the diaza compounds of amides [ , such as above mentioned imidazole derivatives, an above mentioned dicyandiamide, etc., ], 1, and 8-diazabicyclo (5.4.0) undecene-7 grade and those phenols, said multiple-valued carboxylic acids, or phosphinic acid, triphenyl phosphine, and tetra-phenyl phosphonium tetraphenylborate, 2 and 4, and 6-tris aminomethyl phenol, etc. are mentioned. although it is suitably chosen by the class of the cure rate of the powder coatings obtained, hardened material nature, and curing agent which [ of these hardening accelerators ] is used -- desirable -- imidazole derivatives -- it is imidazole system azine derivative, 2 [ for example, ], and 4-diamino-6-(2'-methyl imidazole (1')) ethyl-s-triazine still more preferably. the blending ratio of coal of these hardening accelerators -- the epoxy resin 100 weight section -- receiving -- usually -- 0.01 - 5 weight section -- desirable -- 0.05 - 3 weight section -- it is 0.1 - 2 weight section still more preferably.

[0016] The inorganic filler (D) used in this invention is glass. As glass, inorganic glass, such as silicate glass, phosphate glass, and boric-acid glass, is desirable, for example. It is silicate glass, such as silicic acid alkali glass, soda lime glass, potash lime glass, lead glass, barium glass, boro-silicated glass, alumino boro-silicated glass, and alumino silica glass, more preferably. What is in a coupling agent etc. and performed surface treatment can be used. The configuration of glass has a desirable bead-like thing. A bead is a globular form (the shape of an ellipse is also included) bead, and can also use a hollow bead for the purpose. The particle size has a 5-50-micrometer desirable thing as mean particle diameter (weight).

[0017] Moreover, it is desirable that the content of a thing with a particle size of 250 micrometers or more is 3 or less % of the weight more preferably 10 or less % of the weight at the time of 5 or less % of the weight, especially thin film-ized use in the glass bead grain size measured with the coal tar multi-sizer (COULTER MULTISIZER) particle-size-analysis plan if the dimensional stability of the moldings after processing by small and thin-film-izing of a moldings is taken into consideration. Moreover, when post-processing nature is taken into consideration, it is desirable to use the glass bead with which DPH50 (50g of Diamond Pyramid Hardness loads) has the degree of hardness of two or less [ 750kg //mm ] 50% of the weight or more in solid-stowing material, and it is more desirable to use what has the degree of hardness of two or less [ 670kg //mm ] especially. Moreover, when thermo-cycle-proof nature and crack-proof nature are taken into consideration, it is desirable to use the glass bead whose coefficient of linear expansion is below  $100 \times 10^{-7}$  (1/degree C), and it is desirable that coefficient of linear expansion uses [ coefficient of linear expansion ] the glass bead below  $50 \times 10^{-7}$  (1/degree C)

especially more preferably the 60x10 to 7 (1/-degree C) following.

[0018] The amount of these glass (bead) used is 65 - 40% of the weight of the range more preferably 70 to 35% of the weight 75 - 30 % of the weight of constituent Naka. At 30 or less % of the weight, there is an inclination to be unable to contribute to the fall of the coefficient of linear expansion of a moldings greatly, but for thermo-cycle-proof nature to fall. Moreover, if it exceeds 75 % of the weight, it will become disadvantageous in respect of post-processing nature.

[0019] In this invention, various inorganic fillers other than glass (D) can be used together. As an inorganic filler which can be used together, a melting crushing silica, a crystal crushing silica, a spherical silica, silicon carbide, boron nitride, a calcium carbonate, a magnesium carbonate, a barium sulfate, a calcium sulfate, a mica, talc, clay, an aluminum oxide, magnesium oxide, a zirconium dioxide, an aluminum hydroxide, a magnesium hydroxide, a calcium silicate, aluminum silicate, silicic acid lithium aluminum, a silicic acid zirconium, barium titanate, a carbon fiber, molybdenum disulfide, etc. are mentioned, for example. If the amount used is a quantitative ratio which does not have big effect on post-processing nature, it does not have especially a limit and is 30 or less % of the weight still more preferably 40% of the weight preferably 50 or less % of the weight, for example to the amount of solid-stowing material as a standard. The mean particle diameter of these inorganic fillers has desirable 5-50 micrometers. Moreover, what performed surface treatment by the coupling agent can be used.

[0020] The silicone rubber (E) added by this invention is synthetic rubber which silicon rubber is generally also told to and the principal chain becomes from ORGANO siloxane joint-(SiR2O) n-. As R group, although a methyl group is common, in order to make this make bridge formation easy, what transposed the part to the vinyl group, and the thing which introduced various substituents, such as a phenyl group and a fluorine alkyl group, further may be used, and what silicone rubber commits as an elastic body in ordinary temperature can be used. This silicone rubber (E) has a desirable powder-like thing, and 0.5-30 micrometers of 0.5-10 micrometers of that mean particle diameter are 0.5-3 micrometers still more preferably preferably. the amount used -- the epoxy resin 100 weight section -- receiving -- 3 - 20 weight section -- desirable -- 5 - 15 weight section -- it is 5 - 10 weight section still more preferably. What carried out surface treatment by the coupling agent can be used for the above-mentioned silicone rubber.

[0021] In the constituent of this invention, a coloring agent, a coupling agent, a leveling agent, lubricant, etc. can be suitably added according to the purpose. Phthalocyanine, azo, JISUAZO, Quinacridone, anthraquinone, flavanthrone, and peri non, as a coloring agent, there is especially no limit and the various organic system coloring matter of perylene, dioxazine, condensation azo, azomethine, or a methine system is mentioned for titanium oxide, a lead sulfate, a zinc oxide, chrome yellow, zinc yellow, Chrome Vermilion, rouge, cobalt purple, Berlin blue, ultramarine blue, carbon black, chrome green, chromic oxide, cobalt green, etc. as an inorganic pigment again.

[0022] As a coupling agent, a silane system coupling agent, a titanium system coupling agent, a zirconium system coupling agent, a \*\* aluminate coupling agent, etc. are mentioned, for example. They are a silicon system coupling agent or a titanium system coupling agent preferably.

[0023] As a silane system coupling agent, for example 3-glycidoxypolytrimethoxysilane, 3-glycidoxypolydimethoxysilane, 3-glycidoxypolydimethoxysilane, 2-(3, 4-epoxycyclohexyl) ethyltrimethoxysilane, N-(2-aminoethyl)3-aminopropyl methyl dimethoxysilane, N-(2-aminoethyl)3-aminopropyl methyl trimethoxysilane, 3-aminopropyl triethoxysilane, 3-mercapto propyltrimethoxysilane, Vinyltrimethoxysilane, an N-(2-(vinylbenzylamino)ethyl)3-aminopropyl trimethoxysilane hydrochloride, 3-methacryloxy propyl trimethoxysilane, 3-chloropropylmethyl dimethoxysilane, 3-chloropropyltrimethoxysilane, etc. are mentioned.

[0024] As a titanium system coupling agent, it is isopropyl (N-ethylamino ethylamino), for example. Titanate, isopropylisostearoyl titanate, and CHITANYUUMUJI (JIOKUCHIRUPIRO phosphate) Oxy-acetate and tetra-isopropanal PIRUJI (dioctyl FOSU fight) Titanate, neo ARUKOKISHITORI (p-N-(beta-aminoethyl) aminophenyl) titanate, etc. are mentioned. As a zirconium system coupling agent, for example Zr-acetylacetonate, Zr-methacrylate, Zr-propionate, neo alkoxy zirconate, NEOARUKOKISHITORISU neo decanoyl zirconate and neo alkoxy tris (dodeca noil) Benzene

sulfonyl zirconate, Neo alkoxy tris (ethylene diamino ethyl) zirconate, Neo alkoxy tris (m-aminophenyl) Zirconate, ammonium zirconium carbonate, etc. are mentioned and aluminum-acetylacetonate, aluminum-methacrylate, aluminum-propionate, etc. are mentioned as an aluminate coupling agent, for example.

[0025] As a leveling agent, the oligomer of the molecular weight 4000-12000 which consists of acrylate, such as ethyl acrylate, butyl acrylate, and 2-ethylhexyl acrylate, for example, an epoxidation soybean fatty acid, epoxidation loon ethyl alcohol, hydrogenation castor oil, a titanium system coupling agent, etc. are mentioned. As lubricant, for example, hydrocarbon system lubricant, such as paraffin wax, micro wax, and polyethylene wax, A lauric acid, a myristic acid, a palmitic acid, stearin acid, arachidic acid, Higher-fatty-acid system lubricant, such as behenic acid, a stearyl amide, a palmityl amide, Higher-fatty-acid amide system lubricant, such as oleylamide, methylenebisstearamide, and ethylene-bis-stearamide, Hardening castor oil, butyl stearate, ethylene glycol monostearate, Higher-fatty-acid ester system lubricant, such as pentaerythritol (Monod, G, tree, or tetrapod -) stearate, Cetyl alcohol, stearyl alcohol, a polyethylene glycol, Alcoholic system lubricant, such as poly glycerol, a lauric acid, a myristic acid, A palmitic acid, stearin acid, arachidic acid, behenic acid, a ricinoleic acid, Natural waxes, such as metallic soap which are metal salts, such as magnesium, such as a naphthenic acid, calcium, cadmium, barium, zinc, and lead, a carnauba wax, candelilla wax, a dense low, and montan wax, are mentioned.

[0026] The epoxy resin powder coatings of this invention knead each above-mentioned component, are obtained, are usually pulverized, and use is presented with them. The average grain size of this grinding object usually has desirable 20-500 micrometers. In order to prepare these epoxy resin powder coatings, for example, the above-mentioned epoxy resin, Combination components, such as a coupling agent, a flame retarder, a coloring agent, a leveling agent, and lubricant, are used for a Henschel mixer etc. by request besides a curing agent, a hardening accelerator, and a filler. By the kneader, an extruder, etc. after dry blending For example, after performing melting mixing processing below 110 degrees C more than the melting temperature of an epoxy resin (A), cooling solidification of the mixture is carried out, and pulverizing Ushiro classification is carried out, and the thing of a desired grain size is extracted and it considers as epoxy resin powder coatings.

[0027] The goods of this invention are the goods painted by the various methods of application, such as a fluidized bed coating process, an electrostatic flow tub method, an electrostatic spray method, and cascade process, using the epoxy resin powder coatings of this invention, for example, the locked rotor for motors is mentioned. Paint of this rotor is painted inside a core front face, a core, and a coil. For example, when painting using a fluidized bed coating process, although what is necessary is just more than the melting temperature of powder coatings, preferably, at 160 degrees C - 190 degrees C, after a preheating, it is immersed and 150 degrees C - 200 degrees C of rotator cores are painted at a fluidized-bed-dip-coating tub. Therefore, the powder coatings adhering to a core front face are fused on the core front face. Next, full hardening of the melt is carried out by heating this rotator core further. As whenever [ stoving temperature ], 140 degrees C - 150 degrees C - 210 degrees C 220 degrees C are 160 degrees C - 200 degrees C still more preferably preferably. Heating time is 10 minutes - 1 hour. In this way, the rotator of this invention is obtained by carrying out cutting removal of the hardened excessive resin which has fixed on core front faces other than the core space section of the obtained rotator with a cutting tool cutting edge etc. Moreover, it is processed by attaching the above-mentioned rotator with need components, such as bearing and York, and the motor which has the rotator of this invention is obtained.

[0028]

[Example] Next, although an example explains this invention still more concretely, this invention is not limited only to these examples. In an example and the example of a comparison, the "section" means the weight section. Moreover, the content of a thing with a particle size [ in a glass bead ] of 250 micrometers or more is the value measured with the coal tar multi-sizer particle-size-analysis plan.

[0029] example 1 EPO MIKKU R-302 (the product made from the bisphenol A mold epoxy resin Mitsui petrochemistry --) 85 degrees-C 55 sections of softening temperatures, and EPO MIKKU R-304 (the



epoxy 100 (55, 10, 35)  
150  
DCD (0.6, 4.4)  
39.2% epoxy  
1.8% curing agent

bisphenol A mold epoxy resin --) the product made from the Mitsui petrochemistry, 105 degrees-C ten sections of softening temperatures, and EOCN-104S (a cresol novolak mold epoxy resin --) The Nippon Kayaku make, 92 degrees-C 35 sections of softening temperatures, a soda lime glass bead (the weighted mean particle size of 27 micrometers) The content of a thing with a particle size of 250 micrometers or more Three or less % of the weight, 50= 670 or less DPH, coefficient-of-linear-expansion = -- the below  $100 \times 10^{-7}$  (1-/degree C) 150 section and a titanate system coupling agent (the Ajinomoto make --) the 46BKR-0.6 section and a dicyandiamide (a curing agent and the product made from oil-ized shell epoxy --) The DICY7 4.4 section, the 2 MZ-A(Shikoku formation hardening-accelerator, make, 2 MZ-A) 1.5 section, After the mixer's having ground the silicone powder (Dow Corning Toray Silicone make, AY 49-281) 6 section and the leveling agent (Kusumoto formation make, PL- 525) 1 section and mixing, melting mixing was carried out using the biaxial kneader. After cooling the obtained kneading object and solidifying, it ground and the epoxy resin powder coatings of this invention were obtained through 250-micrometer screen. Subsequently, the obtained epoxy resin powder coatings were applied to the locked rotor of 60mmphi and 45mm of product thickness by which the preheating of the element assembly temperature was carried out to 180 degrees C by the fluidized bed coating process, and carried out postcure under the conditions for 180 more degree-Cx 10 minutes, and the locked rotor which applied the powder coatings of this invention was obtained.

[0030] The example 2 EPO MIKKU R-302 (product made from Mitsui petrochemistry, 85 degrees C of softening temperatures) 55 section, The EPO MIKKU R-304 (product made from Mitsui petrochemistry, 105 degrees C of softening temperatures) 10 section, The EOCN-104S (Nippon Kayaku make, 92 degrees C of softening temperatures) 35 section, a way silicic acid glass bead (the weighted mean particle size of 17 micrometers) The content of a thing with a particle size of 250 micrometers or more Three or less % of the weight, 50= 670 or less DPH, coefficient-of-linear-expansion = -- the below  $50 \times 10^{-7}$  (1-/degree C) 150 section and a titanate system coupling agent (the Ajinomoto make --) the 46BKR-0.6 section and a dicyandiamide (the product made from oil-ized shell epoxy --) The DICY7 4.4 section, the 2 MZ-A(Shikoku formation make, 2 MZ-A) 1.5 section, After the mixer's having ground the silicone powder (Dow Corning Toray Silicone make, AY 49-281) 6 section and the leveling agent (Kusumoto formation make, PL- 525) 1 section and mixing, melting mixing was carried out using the biaxial kneader. After cooling the obtained kneading object and solidifying, it ground and the epoxy resin powder coatings of this invention were obtained through 250-micrometer screen. Subsequently, the obtained epoxy resin powder coatings were applied to the locked rotor of 60mmphi and 45mm of product thickness by which the preheating of the element assembly temperature was carried out to 180 degrees C by the fluidized bed coating process, and carried out postcure under the conditions for 180 more degree-Cx 10 minutes, and the locked rotor which applied the powder coatings of this invention was obtained.

[0031] The example of comparison 1 EPO MIKKU R-302 (product made from Mitsui petrochemistry, 85 degrees C of softening temperatures) 55 section, The EPO MIKKU R-304 (product made from Mitsui petrochemistry, 105 degrees C of softening temperatures) 10 section, The EOCN-104S (Nippon Kayaku make, 92 degrees C of softening temperatures) 35 section, the spherical silica (mean particle diameter of 27 micrometers) 129.4 section, The titanate system coupling agent (Ajinomoto make, KR-46B) 0.6 section, The dicyandiamide (product made from oil-ized shell epoxy, DICY7) 4.4 section, After the mixer's having ground the 2 MZ-A(Shikoku formation make, 2 MZ-A) 1.5 section, the silicone powder (Dow Corning Toray Silicone make, AY 49-281) 6 section, and the leveling agent (Kusumoto formation make, PL- 525) 1 section and mixing, melting mixing was carried out using the biaxial kneader. After cooling the obtained kneading object and solidifying, it ground and the epoxy resin powder coatings for a comparison were obtained through 250-micrometer screen. Subsequently, element assembly temperature applied the obtained epoxy resin system powder coatings to the locked rotor of 60mmphi and 45mm of product thickness by which the preheating was carried out to 180 degrees C by the fluidized bed coating process, carried out postcure under the conditions for 180 degree-Cx 10 minutes, and considered as the sample for a comparison.

[0032] The engine performance of the paint product which painted the epoxy resin powder coatings of

this invention, and was obtained, and the sample for a comparison was evaluated. A result is shown in Table 1. In addition, a performance-evaluation method and the valuation basis are as follows.

[0033] (1) the sample obtained in forced-cooling trial each example and each example of a comparison - two or more 5 kgf/cm air -- blasting during 10 minutes -- it cooled compulsorily. At that time, the situation of the crack in the element assembly section was observed, it classified with the next notation, and O was judged to be forced-cooling nature "fitness."

O : there is no crack immediately after forced cooling, and several days after is eternal.

x: One or more cracks are immediately after forced cooling.

[0034] (2) This invention obtained by performing cutting processing with the cutting tool cutting edge etc. by extent to which a core surface of metal exposes excessive hardening resin from this rotator core front face of thermo-cycle test above-mentioned forced-cooling trial Ushiro, and the rotator for a comparison were used as the test piece for a thermo-cycle trial. - The thermo-cycle trial was carried out under the conditions of 10 cycles in 30 degrees C - 160 degree-Cx 2 hours each. After the trial, the generated crack was classified as follows and evaluated.

O : a thing without the destructive crack to the resin layer of the slot section.

x: A thing with the destructive crack to the resin layer of the slot section.

[0035] (3) About each periphery hardening resin cutting processing sex-test powder coatings, when it applied to 40 rotators each and periphery hardening resin was cut, the wear condition of a cutting tool cutting edge was observed under the microscope, what has few extent of wear was made into O, and extent of wear made the remarkable severe thing x.

[0036]

[Table 1]

table 1 [ ] example 1 Example 2 Example of comparison 1 forced-cooling trial O O O Thermo-cycle trial

O O O cutting processing sex test O O x [0037] The hardened material of the constituent of this invention has the crack-proof nature by forced cooling, thermo-cycle-proof nature, and good periphery hardening resin cutting ability so that clearly from Table 1.

[0038]

[Effect of the Invention] The glass bead (D) and the epoxy resin constituent of this invention which contains silicone rubber (E) as a stress relaxation agent are useful as powder coatings for locked rotors which were excellent in impregnating ability, were excellent in the forced-cooling resistance and thermo-cycle-proof nature after heat hardening, and were further excellent in especially periphery cutting processability as an epoxy resin (A), a curing agent (B), a hardening accelerator (C), and an inorganic filler.

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[Translation done.]

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**CLAIMS**

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[Claim(s)]

[Claim 1] An epoxy resin (A), a curing agent (B), a hardening accelerator (C), the epoxy resin constituent that contains silicone rubber (E) as glass (D) and a stress relaxation agent as an inorganic filler.

[Claim 2] The epoxy resin constituent according to claim 1 whose epoxy resin (A) is mixed resin of the bisphenol mold epoxy resin (a) of weight per epoxy equivalent 450-1000, and the novolak mold polyfunctional epoxy resin (b) of weight per epoxy equivalent 190-220.

[Claim 3] The epoxy resin constituent according to claim 1 or 2 whose curing agent (B) is a dicyandiamide.

[Claim 4] An epoxy resin constituent given in claim 1 whose hardening accelerator (C) is an imidazole system azine derivative thru/or any 1 term of 3.

[Claim 5] An epoxy resin constituent given in claim 1 whose glass (D) is a glass bead thru/or any 1 term of 4.

[Claim 6] The epoxy resin constituent according to claim 5 whose glass bead (D) is a glass bead which has DPH50 value of two or less [ 750kg //mm ].

[Claim 7] The epoxy resin constituent according to claim 5 or 6 whose glass bead (D) is a glass bead which has the coefficient of linear expansion below  $100 \times 10^{-7}$  (1-/degree C).

[Claim 8] An epoxy resin constituent given in claim 5 whose content of the bead which has the particle size of 250 micrometers or more in a glass bead (D) is 10 or less % of the weight thru/or any 1 term of 7.

[Claim 9] An epoxy resin constituent given in claim 5 whose glass bead (D) is a soda ash glass bead thru/or any 1 term of 8.

[Claim 10] An epoxy resin constituent given in claim 5 whose glass bead (D) is a bead made from way silica glass thru/or any 1 term of 8.

[Claim 11] Epoxy resin powder coatings which become claim 1 thru/or any 1 term of 10 from the epoxy resin constituent of a publication.

[Claim 12] Goods painted with epoxy resin powder coatings according to claim 11.

[Claim 13] Goods of claim 12 whose goods are locked rotors.

[Claim 14] The motor which has the locked rotor of claim 13.

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[Translation done.]